

Claims

- 1 1. A process, comprising: a) reacting a an alkoxysilane, an
2 (epoxy)alkoxysilane, and a fluorinated alkoxysilane to form a fluorinated sol-gel
3 polymer; and b) reacting a nonlinear optical chromophore comprising a donor, a π -
4 bridge, an acceptor, and at least one alkoxysilyl group with the fluorinated sol-gel
5 polymer to form a nonlinear optical fluorinated sol-gel polymer.
- 1 2. The process of Claim 1, wherein the alkoxy group of one or more of the
2 alkoxysilane, the (epoxy)alkoxysilane, the (fluoroalkyl)alkoxysilane, or the alkoxysilyl
3 group of the nonlinear optical chromophore is independently selected from the group
4 consisting of methoxy, ethoxy, propoxy, isopropoxy, butoxy, and any combination
5 thereof.
- 1 3. The process of Claim 1, wherein the alkoxysilane is a tetraalkoxysilane.
- 1 4. The process of Claim 1, wherein the (epoxy)alkoxysilane further
2 comprises one alkyl group.
- 1 5. The process of Claim 1, wherein the (epoxy)alkoxysilane comprises two
2 epoxy groups.
- 1 6. The process of Claim 1, wherein the (epoxy)alkoxysilane comprises an
2 epoxyalkyl group, a epoxycycloalkyl group, or any combination thereof.
- 1 7. The process of Claim 6, wherein the (epoxy)alkoxysilane comprises a 3-
2 (2,3-epoxypropoxy)propyl group, a 5,6-epoxyhexyl group, a 2-(3,4-
3 epoxycyclohexyl)ethyl group, or any combination thereof.
- 1 8. The process of Claim 1, wherein the fluorinated alkoxysilane comprises a
2 fluorinated group including up to about 20 carbon atoms.

1 9. The process of Claim 8, wherein the fluorinated group is selected from the
2 group consisting of a 3,3,3-trifluoropropyl group, a 3-(heptafluoroisopropoxy)propyl
3 group, a pentafluorophenyl, pentafluoro-phenylpropyl group, a perfluoro-1,1,2,2-
4 tetrahydrohexyl group, a perfluoro-1,1,2,2-tetrahydrooctyl group, a perfluoro-1,1,2,2-
5 tetrahydrodecyl group, a perfluoro-1,1,2,2-tetrahydrododecyl group, a perfluoro-1,1,2,2-
6 tetrahydrododecyl group, and any combination thereof.

1 10. The process of Claim 1, wherein the fluorinated alkoxy silane comprises
2 two fluoroalkyl groups.

1 11. The process of Claim 1, wherein the fluorinated alkoxy silane comprises a
2 fluorocycloalkyl group.

1 12. The process of Claim 1, wherein the molar ratio of the fluorinated
2 alkoxy silane to the (epoxy)alkoxy silane is greater than about 0.1 to 4.

1 13. The process of Claim 1, wherein the weight percent of the nonlinear
2 optical chromophore in the fluorinated sol-gel polymer is about 10 weight percent to
3 about 50 weight percent.

1 14. The process of Claim 1, comprising catalyzing the reaction of the
2 tetraalkoxy silane, the (epoxy)alkoxy silane, and the fluorinated alkoxy silane with a
3 catalyst comprising deuteriochloric acid in deuterium oxide.

1 15. The process of Claim 1, further comprising c) forming a thin film
2 comprising the nonlinear optical fluorinated sol-gel on a substrate; and d) poling the
3 nonlinear optical fluorinated sol-gel to form an electro-optic fluorinated sol-gel.

1 16. The process of Claim 15, wherein forming the thin film comprises spin
2 coating, dip coating, or brushing.

1 17. The process of Claim 15, wherein the substrate further comprises a
2 cladding material, the cladding material having an index of refraction lower than the
3 index of refraction of the electro-optic fluorinated sol-gel.

1 18. The process of Claim 17, wherein the cladding material comprises a
2 polymer.

1 19. The process of Claim 1, wherein the alkoxyethyl group of the nonlinear
2 optical chromophore comprises a trialkoxyethyl group.

1 20. The process of Claim 1, wherein the alkoxyethyl group of the nonlinear
2 optical chromophore is attached to the donor.

1 21. The process of Claim 1 wherein the alkoxyethyl group of the nonlinear
2 optical chromophore is attached to the acceptor.

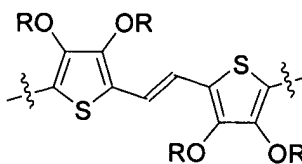
1 22. The process of Claim 1, wherein the nonlinear optical chromophore
2 comprises two alkoxyethyl groups.

1 23. The process of Claim 22, wherein the two alkoxyethyl groups are attached
2 to the donor.

1 24. The process of Claim 23, wherein one alkoxyethyl group is attached to the
2 donor and one alkoxyethyl group is attached to the acceptor.

1 25. The process of Claim 1, wherein the π -bridge comprises a thiophene ring
2 having oxygen atoms bonded directly to the 3 and 4 positions of the thiophene ring.

1 26. The process of Claim 25, wherein the π -bridge has the structure



3 wherein R is an alkyl group, a heteroalkyl group, an aryl group, or a heteroaryl
4 group.

1 27. A composition prepared according to the process of claim 1 or 15.

1 28. An electro-optic device comprising the composition of claim 27.

1 29. The electro-optic device of claim 28, including a Mach-Zehnder modulator, a
2 directional coupler, or a micro-ring resonator.